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ABSTRACT

Commonalities and differences in the perception of competence among three levels of medical laboratory personnel were assessed through a survey of 100 educators, chief technologists, and working technicians. Respondents rated medical technologists (MTs), medical laboratory technicians (MLTs), and certified laboratory assistants (CLAs) on 270 tasks in six areas concerning the clinical laboratory. Responses to a Likert-type scale were analyzed by multivariate statistical analysis. It was found that educators, chief technologists, and MLT graduates rated the medical technology the same; chief technologists rated MLTs lower than did educators or graduates; and chief technologists also rated CLAs lower. Specific conclusions relating to competence in hematology are as follows: educators perceived MTs to be more competent in hematology than did chief technologists or graduates; chief technologists rated MLTs and CLAs less competent than MTs and MLTs in hematology; chief technologists rated MTs, MLTs, and CLAs at three levels (in descending order) of competence in hematology; and MLT graduates rated themselves as competent as MTs and more competent than CLAs in hematology. Biographical data submitted by respondents show that slightly over half of the educators and chiefs had more than 10 years of experience in laboratory medicine, and almost half of MLT graduates worked in hospitals of more than 200 beds. Correlations between the 1973 "Position Paper" of the American Society for Medical Technology, the 1978 "Statements of Competence," and the 1980 "Course Outline" of ASMT are examined. A bibliography is appended. (SW)

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Judith A. Davis, PhD: "Perceptions of Competence of Three Levels of Medical Laboratory Personnel"

Abstract

The proliferation of educational programs for three levels of medical laboratory personnel during the 1970s is now demanding an evaluation of those levels. This study was designed to identify commonalities and differences in the perception of competence among the three levels. A sample of 150 laboratorians, including educators, chief technologists, and working technicians was surveyed. Each of the 100 respondents rated MTs, MLTs, and CLAs on 270 tasks in six areas of the clinical laboratory. Responses to a Likert-type scale were analyzed with multivariate statistical methods. Results showed that differences in degree of competence were perceived for the three levels by all categories of raters. Differences in perception of competence among levels varied according to the clinical area rated. Demographic and statistical data will be presented along with specific examples from ratings in hematology. The presentation will conclude with applications of the findings to ASMT's "Statements of Competence."

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PERCEPTIONS OF COMPETENCE OF THREE LEVELS OF MEDICAL LABORATORY PERSONNEL

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Introduction

For more than a decade modern hospital laboratories have been staffed with three levels of certified laboratorians, and educational institutions as well as hospitals have provided training programs for those levels. The 1960s saw the establishment of CLA (MLT-C) programs. The 1970s saw the proliferation of MLT-Associate Degree programs. These levels arose in part as a response to the Higher Education Act of 1963 and the Allied Health Training Act of 1966. Meanwhile, MT programs were changing their focus somewhat by requiring at least three years of college prior to clinical training or two years of college plus two years of MT training.

While three distinct levels exist, laboratorians in each level of certification may typically perform 90% of the routine procedures in the average hospital laboratory as they work alongside each of the other personnel levels. Some have asked if three levels are required or even desired for staffing. Now that the establishment of these levels of education is history, educators and practitioners have seen the need to evaluate the effectiveness of the programs in light of job descriptions, task analyses, competence assurance, career mobility, job satisfaction, and impact of programs on the cost effectiveness and quality of care provided by hospital laboratories.

Other studies on task analyses have been undertaken by Bailey, in 1973; Hedrick and Fiene in 1974 and 1975; Gleich, in 1974; Love in 1976; Dietrich in 1976, and Rausch in 1977. Most data were published more than five years ago when many MLT-AD programs were just beginning. Because of this, the present study was done. Through the use of a task analysis questionnaire, this study examined the degree of competence of each of the three levels as perceived by educators, chief technologists, and MLT

graduates. One state (North Carolina) was selected for this research since MLT graduates have been employed there at least five years. Five-year studies have occurred for other levels, but no such longitudinal study was located for MLTs.

The purposes of the study were to identify 1) tasks performed by the three levels of laboratorians, 2) commonalities and differences in competence for the three levels, and 3) characteristics of educators, chief technologists and MLT graduates, who served as raters of the questionnaires.

Method

The methodology concerned mailing a task analysis questionnaire, containing 270 tasks in six clinical areas, to a group of 150 laboratorians. The group included educators from 25 programs (all three levels), chief technologists from 46 hospitals, and graduates from six classes of MLTs from one school. Using a four-point, Likert-type scale, respondents rated their perceptions of the competence of each of the three levels of laboratorians on each of the 270 tasks. A total of 100 persons responded. Data were analyzed with univariate and multivariate statistics.

The statistical design was an ex post facto field study which had as its model a 3 x 2 factorial structure. There were three categories of raters which served as an independent variable (X_1). These were educators, chief technologists, and MLT graduates. There were two levels of raters--MT and MLT. Level served as a second independent variable (X_2). The primary dependent variables or mean scores on all tasks were the scores or ratings on MT (Y_1), MLT (Y_2), and CLA (Y_3). These dependent variables were subdivided into scores for each clinical area: urinalysis, blood bank, serology, chemistry, microbiology, and hematology. These area scores provided 18 additional dependent variables.

DESIGN OF PERCEPTIONS OF COMPETENCE STUDY

3 x 2 Factorial for ANOVA

CATEGORY (X_1)	LEVEL (X_2): MT	LEVEL (X_2): MLT
Eds	$Y_1 \ldots Y_{21}$	$Y_1 \ldots Y_{21}$
Chfs	$Y_1 \ldots Y_{21}$	$Y_1 \ldots Y_{21}$
Grads	$Y_1 \ldots Y_{21}$	$Y_1 \ldots Y_{21}$

X_1 = Category of rater

X_2 = Level of rater

Y_1 = Rating on MT

Y_2 = Rating on MLT

Y_3 = Rating on CLA

Y_9 = Hematology for MT

Y_{15} = Hematology for MLT

Y_{21} = Hematology for CLA

Because of using several dependent and independent variables in the study, several types of computer-generated statistical procedures (including multivariate and univariate analysis of variance) were selected. The impact of the three categories and two levels of raters on the perceptions of competence of three levels of personnel was examined by testing more than 20 null hypotheses.

General Results

The first three hypotheses concerned the overall ratings or means on all 270 tasks for each level as perceived by the three categories of raters. Conclusions from these three hypotheses, simply stated, were that 1) educators, chief techs, and MLT graduates rated the MT level the same, 2) chief techs rated MLTs lower than educators or graduates did, and 3) chief techs also rated CLAs lower. These hypotheses were tested with Analysis of Variance (ANOVA) and Duncan's Multiple Range Test. A summary of the mean scores on all tasks for each level as perceived by each rater provides an idea of the source of differences in perceptions (see figure 2).

Other hypotheses concerned the rating by one category (i.e., educators) on all three levels of personnel simultaneously. For example, one could pose the following hypothesis: "Educators perceived MTs, MLTs, and CLAs to possess the same level of competence." This hypothesis was rejected since statistical analysis confirmed difference in competence for MTs and CLAs. Three hypotheses for overall scores were tested, and specific hypotheses for hematology will be discussed in hypotheses four through nine which were isolated from the study.

Hematology Results

Since the focus of this presentation is competence in hematology, several hypotheses in hematology now follow. Hypothesis Four stated that

SUMMARY OF MEANS FOR ENTIRE TASK LIST
(270 tasks in six areas)

	MT rating	MLT rating	CLA rating
Educators	3.90	3.35	2.69
Chief Techs	3.68	3.05	2.26
MLT grads	3.71	3.37	2.66
Grand $\bar{x}$	3.76	3.29	2.59

Rating scale: 1=no competence
2=moderate competence
3=considerable competence
4=utmost competence

> educators' perceptions of MT competence in hematology are significantly different from those of either chief technologists or MLT graduates.

The ANOVA on means showed a significant *F* value. Tukey's Honestly Significant Difference indicated that the source of difference in means was educators. The hypothesis was retained (see figure 3) since educators rated MTs higher than the other raters did.

Hypothesis Five stated that

> chief technologists' perceptions of MLT competence in hematology are significantly lower than the perceptions of educators or MLT graduates.

The ANOVA and post-hoc tests showed chief techs to rate MLTs significantly lower (see figure 4).

Hypothesis Six stated that

> perceptions of competence of CLAs in hematology are not significantly different among educators, chief technologists, and MLT graduates.

The ANOVA and post-hoc test showed chief technologists to be the source of variance since they rated CLAs lower (see figure 5).

Hypothesis Seven was stated differently in that the question posed concerned the ratings by one category, educators, on all three levels of personnel:

> No significant difference exists in the perceptions by educators of the competence of MTs, MLTs, and CLAs in hematology.

The testing of this hypothesis required the use of multivariate analysis of variance (MANOVA) since three dependent variables were measured simultaneously. The hypothesis was rejected since the significant *F* value and post-hoc tests confirmed the source of variance to be the rating on CLA, which was significantly lower (see figure 6).

Hypothesis Eight, which also required the use of MANOVA, stated that

> no significant difference exists in the perceptions by chief technologists of the competence of MTs, MLTs, and CLAs in hematology.

HYPOTHESIS FOUR: Statistical results

ANOVA SUMMARY TABLE

Source	SS	df	MS	F
Between groups	.924	2	.462	3.61*
Within groups	8.864	69	.128	
Total	9.788	71		

*p<.05

TUKEY'S HSD

MEAN	GROUP	Gds	Chfs	Eds
3.65	Gds			*
3.69	Chfs			*
3.90	Eds	*	*	

*significant difference between groups

HYPOTHESIS FIVE: Statistical results

ANOVA SUMMARY TABLE

Source	SS	df	MS	F
Between gps	1.979	2	.989	6.51*
Within gps	9.574	63	.152	
Total	11.553	65		

*p<.05

T-tests	t	df
Eds, Chiefs	2.80*	20
Eds, Grads	-.11	40

TUKEY'S HSD

Mean	Gp	Chfs	Eds	Gds
3.13	Chfs		*	*
3.47	Eds	*		
3.51	Gds	*		

12

*shows significant difference between groups

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HYPOTHESIS SIX: Statistical results

ANOVA SUMMARY TABLE

Source	SS	df	MS	F
Between gps	5.808	2	2.904	3.06*
Within gps	72.949	77	.947	
Total	78.758	79		

*p<.05

T-tests

Groups	t	df
Eds, Grads	1.69	20
Eds, Chfs	2.69*	20

*significant difference between groups

HYPOTHESIS SEVEN: Statistical results

ANOVA SUMMARY TABLE

Source	SS	df	MS	F
Between gps	11.007	2	5.50	55.18*
Within gps	5.938	60	.09	
Total	16.946	62		

*p<.05

Multiple Regression on
MT, MLT, CLA Hematology scores
by Educators

$a_o = -2.99$
$a_1 = .63$
$a_2 = .98$

$R^2 = .345$

T-Tests

Groups	t	df
MLT, CLA	2.34*	20
MT, MLT	1.96	20

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The hypothesis was rejected since the significant F value and post-hoc test showed heterogeneity of group means. The levels were rated in descending order of competence as MT, MLT, and CLA mean scores in hematology (see figure 7).

Hypothesis Nine was similar to Seven and Eight and stated that

> no significant difference exists in the perceptions by MLT graduates of the competence of MTs, MLTs, and CLAs in hematology.

This hypothesis was also rejected from similar statistical data which showed by heterogeneity of means that the MLT graduates rated themselves as competent as MTs and more competent than CLAs (see figure 8).

Hypothesis Ten was a composite for hematology. It stated that

> no significant difference exists in the perceptions by all raters of competence in hematology of MTs, MLTs, and CLAs.

Since three categories of raters (the independent variables) and three levels of ratings (the dependent variables) were used, the statistics chosen were MANOVA and its partial correlation coefficients. These data provided a basis for observing significant differences among the means of MT, MLT, and CLA. The partial correlation coefficients showed probable differences between MTs and CLAs. The MT and MLT ratings were more closely correlated. The summary of means (see figure 9) and significant statistics from MANOVA (see figure 10) support these findings.

Discussion of Results

General conclusions were that

1) differences in competence were observed among three levels of laboratorians,

2) differences in perception of competence of MTs were not observed among categories of raters,

3) differences in perception of competence of MLTs were observed among categories of raters,

HYPOTHESIS EIGHT: Statistical results

ANOVA SUMMARY TABLE

Source	SS	df	MS	F
Between gps	17.09	2	8.55	25.01*
Within gps	20.51	60	.34	
Total	37.60	62		

*p<.05

T-tests

Groups	t	df
MT, CLA	7.37*	20
MT, MLT	5.60*	20
MLT, CLA	4.41*	20

*shows significant difference between gps

HYPOTHESIS NINE: Statistical results

ANOVA SUMMARY TABLE

Source	SS	df	MS	F
Between gps	11.12	2	5.56	23.17*
Within gps	14.38	60	.24	
Total	25.50	62		

*p<.05

T-tests

Groups	t	df
MT, MLT	1.48	20
MLT, CLA	4.52*	20

*shows significant difference between groups

HYPOTHESIS TEN

SUMMARY OF MEANS FOR HEMATOLOGY (56 tasks)

	MT rating	MLT rating	CLA rating	$\bar{X}$
Educators	3.94	3.53	2.99	(3.49)
Chief Techs	3.71	3.07	2.41	(3.06)
MLT grads	3.79	3.44	2.84	(3.36)
$\bar{X}$	(3.81)	(3.35)	(2.75)	

PARTIAL CORRELATION COEFFICIENTS FROM MANOVA

df=71

	MT	MLT	CLA
MT	1.0000	.8892	.4806
MLT		1.0000	.6035
CLA			1.0000

HYPOTHESIS TEN

SIGNIFICANT STATISTICS FROM MANOVA
FOR MT(Y1), MLT(Y2), AND CLA(Y3)
in Hematology

Source of variance	Y1 df	Y1 F	Y2 df	Y2 F	Y3 df	Y3 F
CATEGORY	2	9.96*	2	3.69*	2	2.59*
LEVEL	1	.15	1	.83	1	4.59*
INTERACTION	1	.17	1	.82	1	.10

*p<.05

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4) differences in perception of competence of CLAs were observed among categories of raters,

5) differences in perceptions of competence were observed among the ratings of MTs, MLTs, and CLAs in hematology by all raters as a group.

Specific conclusions for hematology included the following:

1) educators perceived MTs to be more competent in hematology than chief techs or graduates thought them to be,

2) chief techs rated MLTs and CLAs less competent in hematology than educators or graduates rated them,

3) educators rated MTs and MLTs equally competent and CLAs less competent than MTs and MLTs in hematology,

4) chief techs rated MTs, MLTs, and CLAs at three levels (in descending order) of competence in hematology,

5) MLT graduates rated themselves as competent as MTs and more competent than CLAs in hematology.

Biographical Findings

Biographical data submitted by respondents showed that most educators and chief technologists were employed when the MLT graduate emerged on the scene of laboratory medicine in the early 1970s. Slightly over half of the educators and chiefs had more than 10 years of experience in laboratory medicine. More than 80% were certified as MT by ASCP. Bench teaching was conducted by 54% of the chief technologists. The similarities of certification, experience, and expertise did not preclude variations in perceptions of competence for chief techs and educators (see figures 11 and 12).

Biographical data from MLT graduates showed that almost half of them worked in hospitals of more than 200 beds. While their mean years of experience were few, some had attained positions as section chiefs, clinical instructors, and shift supervisors. Ten percent had perceived the need for career mobility by achieving B.S. degrees in med. tech. More than 80% expressed their confidence in performing tasks in laboratory medicine, but 63% felt that, for their knowledge and skills, they go largely unrewarded (see figure 13).

BIOGRAPHICAL DATA ON EDUCATORS

Characteristic	Instructional Level MT	MLT	% of Total
Certification			
MT specialist	4	1	19%
MT(ASCP)	12	9	81%
Education			
BS	7	7	54%
MS	8	3	42%
PhD	1		4%
Experience as med tech			
6 to 10 years	5	6	42%
11 to 15 years	10	4	54%
over 15 years	1	1	4%
Area of Expertise			
Bacteriology	4	4	31%
Chemistry	3	3	23%
Hematology	6	3	35%
Blood Bank	3		11%

BIOGRAPHICAL DATA ON CHIEF TECHNOLOGISTS

Characteristic	Size of Hospital (beds)				%
	<100	100-200	200-300	>300	of total
Certification					
MT specialist			2	2	17%
MT(ASCP)	3	5	2	6	67%
MT(HEW)	1	1			8%
MT(AMT)	2				8%
Education					
No degree		1	1		8%
BS	5	5	3	5	75%
MS	1			3	17%
Experience					
10 to 15 years			4	8	50%
15 to 20 years	6	6			50%
Areas of practice					
all areas	3	1	1	2	29%
management	3	2	3	6	58%
chemistry		3			13%
Practice Bench Teaching					
	4	3	2	4	54%

BIOGRAPHICAL DATA ON MLT GRADUATES

Characteristic	#	% of total
Place of First Job		
Hospital, < 100 beds	8	17%
Hospital, 100 to 200 beds	11	24%
Hospital, > 200 beds	22	48%
Clinic	4	9%
Additional Education		
Some college	8	16%
BS	5	10%
MS	1	2%
plan to go back to college	28	58%
no plans to go back	7	14%
Responsibilities		
Routine tests/inventory/QC	18	39%
floater	16	35%
section head	12	26%

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Relationship to "Statements of Competence"

Studies conducted between 1972 and 1977 showed no significant differences for the three levels of medical laboratory personnel. Some studies showed no differences in performance of tasks among levels. The present study has shown significant differences among perceptions of competence of levels of medical laboratory personnel. Now that the CLA level is fading out, greater effort should be placed on identifying commonalities and differences between MTs and MLTs. The ASMT "Statements of Competence" (1978), Body of Knowledge Content Outline (1980), and the recently developed Delineation of Tasks (1981) show that some statements are appropriate for both MTs and MLTs and some, for only the MT level. A comparison was made between five of ASMT's "Statements" and five tasks from the present study's Task Analysis Questionnaire. The similarity was significant for some items (see figures 14, 15, 16).

The first ASMT "Statement" in hematology stated that both MTs and MLTs could

> perform quality control procedures on equipment in hematology with appropriate check systems.

The analogous task from the present study was Hematology Task #223 which stated that one could

> perform general maintenance and quality control of instruments used in hematology.

The frequency distribution on the task showed that all raters as a group perceived that 92% of MTs were fully competent on this task compared to only 55% of MLTs.

The second ASMT "Statement" indicated that both MTs and MLTs were competent to

> identify...and interpret stained preparations (i.e., cytochemical staining in hematology) microscopically using prescribed criteria.

ASMT STATEMENT OF COMPETENCE	TASK FROM COMPETENCE STUDY
"Perform quality control procedures on equipment with appropriate check systems" (MTs & MLTs can perform)	"Perform general maintenance and quality control of instruments used in hematol. 92% of MTs are fully competent. 55% of MLTs--fully competent 27% of CLAs--fully competent
"Identify...and interpret stained preparations microscopically using prescribed criteria." (MTs & MLTs can perform)	"Read and interpret slides prepared with cytochemical stains." 62% of MTs--fully competent 15% of MLTs-fully competent 3% of CLAs-fully competent

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ASMT Statement	Task/Competence Study
"Perform the specific assays of hemostatic function as requested...according to chosen methodology."	"Perform specific coagulation factor assays."
(MT level only)	60% of MTs--fully competent 20% of MLTs-fully competent 9% of CLAs-fully competent
"Correlate the test results with other patient data by integrating test data to lead to a conclusion."	"Recognize logical test results and correlate them with other hematology tests.
(MT level only)	90% of MTs--fully competent 48% of MLTs-fully competent 18% of CLAs-fully competent

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ASMT Statement

"Correlate test results with other patient data...other lab data & physiological & pathophysiological factors & integrate test data to lead to a conclusion about the normality of a system (hemostatic)."

(MT level only)

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Task/Competence Study

"Perform the major screening tests for hemostasis and correlate them with vascular, platelet, and coagulation disorders."

69% of MTs--fully competent
22% of MLTs-fully competent
9% of CLAs-fully competent

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The analogous task from the present study was Hematology Task #238 which stated that one could

> read and interpret slides prepared with cytochemical stains.

The frequency distribution showed 62% of MTs and 15% of MLTs to be fully competent in reading and interpreting these preparations.

The third ASMT "Statement" indicated that only MTs were fully competent to

> perform the special (specific) assays of hemostatic function as requested...according to chosen methodology.

The Hematology Task #261 stated that a laboratorian could

> perform specific coagulation factor assays.

The frequency distribution showed that this task was most appropriate for the MT level since 60% of MTs and 20% of MLTs were perceived to be fully competent to perform it.

The fourth ASMT "Statement" stated that only MTs were fully competent to

> correlate hematology test results with other patient data by integrating test data to lead to a conclusion.

This statement corresponded to the Hematology Task #248 which indicated a laboratorian could:

> recognize logical test results and correlate them with other hematology tests.

The frequency distribution confirmed the fact that this task was most appropriate for the MT level since 90% of MTs and only 48% of MLTs were perceived to be fully competent on this task.

The fifth ASMT "Statement" stated that only the MTs were fully competent to

> correlate test results with other patient data... other lab data and physiological and pathophysiological factors and integrate test data to lead to a conclusion about the normality of a hemostatic system.

The Hematology Task #254 confirmed appropriateness for the MT level in that the MT could

> perform the major screening tests for hemostasis and correlate them with vascular, platelet, and coagulation disorders.

The frequency distribution showed 69% of MTs and 22% of MLTs to be fully competent on this task.

Conclusions

These few examples show that much work has already been devoted to delineating levels of competence of medical laboratory personnel. The results of the present study have shown some correlation with the 1973 ASMT "Position Paper", the 1978 "Statements of Competence", and the 1980 Content Outline of ASMT. Presumably, the correlation will continue with the Delineation of Tasks just available in June, 1981. The two levels, MT (CLS) and MLT (CLT) appear to be prepared to stay on the laboratory scene for a while. Greater appreciation of differences may come with more specific task detailing and delineation. While this study has shown MTs and MLTs to be closely correlated on some tasks, differences have been shown as well. With this knowledge in mind, perhaps educators can 1) create more alliances for career mobility, 2) stimulate interdisciplinary education, and create justification for the level and length of educational programs. The Body of Knowledge Content Outline and its subsequent Delineation of Tasks together become a first step in providing a better understanding of the various levels of laboratory education and practice. Some who have addressed the future of allied health education have indicated that the technician level is here to stay. Data from this study have supported those ideas. Perhaps with this specific delineation of roles (tasks) will come greater knowledge of the true competence possessed by each laboratorian.

While largely a statistical treatise, this study has attempted to provide additional knowledge concerning competence among levels of laboratory personnel. Statistical conclusions indicate that differences do exist between and among levels of personnel.

Judith A. Davis
June 24, 1981

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